

In those SV film structures, the underlined parts are those considered as specular reflection films.

In the SV film (c), the upper and lower specular reflection films are of an oxide. Simply, it is considered that insulating oxides having a high potential barrier are more effective than metals for electron wave reflection, as having higher mirror-reflectivity. In addition, since the NiO film is not only a reflective oxide film but also an antiferromagnetic film, it further acts to spin the magnetization of the magnetic layer adjacent to NiO. The above are D-SV films. It is believed that even normal SV films, reversal SV films and others having a single-layered antiferromagnetic film could enjoy the specular reflection on one side. However, these have some disadvantages and are not practicable in the current stage.

First, NiO has low magnetic coupling force and its practicability is low. This is because, in a weak magnetic coupling field, the magnetization direction of the pinned magnetic layer is unstable owing to the stray magnetic field from the recording media, and the output will fluctuate. In addition, irrespective of NiO and any other oxides for a cap layer, the contact resistance between the lead electrodes and the upper oxide layer is large. The increase in the contact resistance is unfavorable, as often causing ESD (electrostatic discharge). In addition, where CoFe is used as the free layer,

it is understood that the CoFe layer could not exhibit soft magnetic characteristics if not oriented in fcc(111). Where the free layer is positioned in the lower side, a subbing oxide layer, if used, for the free layer shall not work well as a buffer layer for fcc(111)-orientation buffer for CoFe. With that constitution, the SV film could not have soft magnetic characteristics.

In the SV film (d), the underlayer of NiO is an antiferromagnetic film additionally acting for specular reflection, and the top Au layer is a reflective film. Also in the SV film (e), the top Ag film is a reflective film. In (e), the potential difference between the Ag film and the film surface induces specular reflection. The reason why the noble metal film of Au or Ag is effective as the surface reflective film is not clear. One reason is written in the reference for (d), in which they say that, since the surface diffusion of noble metal films is higher than that of transition metal films, the surface planarity of noble metal films is higher than that of transition metals, and therefore noble metal films will be ready to exhibit surface reflection.

The reflective films of metals are superior to those of oxides, as the former are free from the problem of contact resistance with lead electrodes, which problem, however, is inevitable in the latter. However, the mirror reflectivity of noble metal films of Au or Ag is often lost in practical

devices. This is because, in practical MR devices or MR heads, the SV film is rarely exposed outside but is usually covered with any other additional film.

For example, in shielded MR heads, an upper magnetic gap film of alumina or the like is laminated on the SV film. As so written in the reference for (d), the specular reflection is much influenced by the surface or interface condition. Therefore, if any additional film is provided over the surface of the specular reflection film, the mirror reflectivity of the film shall naturally be varied by the overlying additional film. The film structure in which the MR characteristics of the SV film are varied by the additional film that overlies the SV film is problematic in its practical applications.

In fact, it is reported that, when a Ta film which is generally used as a protective film is laminated on the surface of the Au film in an SV film, then the Au film loses its mirror reflectivity. Accordingly, SV films utilizing the mirror reflectivity on their surface often lose their effect in device structures that are directed to practical applications, and are therefore not practicable.

The SV film (f) incorporates the Au film as the specular reflection film, like in (d). In (f), however, the Au film does not exhibit the reflective effect on its surface, but induces the mirror-reflective effect in the interface between the metal films. In this connection, it is understood that,